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ABSTRACT

The use of a computer-based resource allocation procedure for cooperative education ("sandwich" coursework) at the University of Bath in Great Britain is discussed. Costs of undergraduate sandwich courses are compared with those of the more traditional 3-year, full-time undergraduate courses in British universities. Distinction is made between marginal and fixed costs. The degree course in applied biology is described as an example of one of the many 4-year course patterns. Data are provided to show the expenditure pattern of the average British university in 1979-1980 in support of a biology full-time equivalent undergraduate for 1 year. Costs from placing a student in an industrial work environment result from academic staff commitment, department support staff costs, departmental consumables, and traveling costs. The annual unit costs of the sandwich student is higher than that of the traditional student. Costs of the biology sandwich pattern, which places students in industry for 2 terms during the first 3 years, are compared to those of the chemistry degree, which places students in industry only during the third year. It is concluded that additional academic staff are required in order to provide the necessary support for the sandwich system. (SW)

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A COST BASIS FOR RESOURCE ALLOCATION FOR SANDWICH COURSES

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A COST BASIS FOR RESOURCE ALLOCATION FOR SANDWICH COURSES*

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Summary

Cooperative education ("sandwich" course work) has been offered by the University of Bath and its antecedent institution in twenty different subjects for the last twenty-five years. Since 1974, a detailed, computer-based resource allocation procedure has been used. This is described in outline and is used as the basis for a cost comparison between full-time and sandwich degree courses.

Introduction

The University of Bath (and its antecedent institution) has just passed the silver jubilee year for its sandwich courses (cooperative education) in twenty different subjects covering all fields of study in the university. During the last twenty-five years, there has been an evolutionary development and integration (described below) of the courses, with a complex intermingling of semesters, three term (trimester) years, and full years in industry, commerce and government-sponsored organisations.

This paper describes an approach to resource allocation which has proved acceptable to the university since 1974 and which has been agreed to by the University Grants Committee (U.G.C.), the body which distributes resources to the United Kingdom universities.

The analysis which follows describes the distinctive pattern of undergraduate sandwich courses and sets out to compare the costs of such courses with those of the more traditional three-year, full-time undergraduate courses in British universities.

The costs of the traditional course are approximated and then modified on the basis of identifiable differences imposed by the sandwich pattern of training. For the sake of clarity, the paper simplifies the analysis although distinction is made between marginal and fixed costs, which must be taken into account in the application of the method.

The total expenditure on, say, biology faculty salaries is known for all 45 U.K. universities teaching biology. The exact student load is also known, by level of study (undergraduate, postgraduate programmes, and doctoral programmes) and also by full-time and part-time study. The larger the student load, the greater is the expenditure on faculty. This is to be expected. The relationship is estimated by fitting a regression line by "least squares" such that:
expenditure = (weighted student load x slope) + intercept.
The weighting of students for level of study was discussed in Taylor (1982). The intercept is the fixed cost which is independent of the student load. The slope is the marginal cost. Each additional student increments the total expenditure by this marginal cost.

The Degree in Applied Biology

The degree course in applied biology is described as an example of one of the many four-year course patterns in use in the university. The student enrols for the specific degree course, is then committed to a closely defined curriculum and timetable for the next four years, and does not have the flexibility associated with a course-credit or credit-hours syllabus. It is usual in U.K. universities for *all* first-year students on a degree course to attend an identical series of lectures and practical classes, and such uniformity is likely to continue through their second year of study. Only in the final year(s) of any particular course are there likely to be optional pathways to be followed—and these pathways are usually subject related. For example, the biology student can opt in his third and fourth years to specialise in animal or plant physiology, or microbiology . . . and so on.

During his course, the student, together with his colleagues, will study such things as mathematics, management, electronoptics, biochemistry, and other related subjects. It would be misleading to consider this as the equivalent of major and minor subject divisions because the ancillary subjects are taught in a specifically supportive way to the principal discipline.

The industrial training periods are integrated with the principal discipline in a similar way. These characteristics are emphasised because they allow a precision in the costings which may not be so easily achieved in a major-minor credit-hour course pattern.

The degree course in applied biology is of four

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years' duration and consists of nine terms at the university in full-time study interspersed with three separate *six-month* periods on work experience "placement" with employers. The pattern is illustrated in Table 1.

Table 1

The Arrangement of the Four-Year Sandwich Course in Applied Biology

Key: UNIV = University tuition; IND = Industrial period; LV = Long vacation

Year	Year 1	Year 2	Year 3	Year 4
Term	1 2 3 LV	1 2 3 LV	1 2 3 LV	1 2 3 LV
Sandwich stage	UNIV IND	UNIV IND	UNIV IND	UNIV

It will be seen that the student has no long summer vacation throughout the course until after "finals" have been taken in year four, although his employers may allow him two or three weeks' paid leave during the period. The other long vacations are absorbed into the three industrial periods. This is known as a "thin" sandwich.

Other degree courses have different patterns of industrial involvement, some with three years spent full time in the university and one intercalated year spent in industry. This pattern is referred to as a "thick" sandwich. In both cases, nine terms (trimesters) are spent in full-time study, and the academic content is the same as that of the traditional full-time degree course. Yet other patterns involve an "end-on" arrangement, where the second-year group of students returns from its industrial placement and the third-year group replaces it in industry. This provides continuity in the employer's total labour force.

The sandwich courses offered in Bath are "integrated" in that the industrial experience is closely related to the academic programme of the university. The student is not only responsible to his industrial supervisor, but his progress is closely monitored by his academic tutors throughout the industrial period. This university involvement has resource implications for the university, as will be seen.

Full-Time Equivalent Student (FTE) Calculations

A Full-Time Equivalent Student is defined as a student who attends his timetabled classes (say, 22 hours per week) for a full academic year, which is usually of 30 weeks' duration.

Resource allocation in the university is computerised, although the indications are subordinated to academic judgment. Each course syllabus is converted into a computer programme allowing for hours taught by the "parent" school (i.e., the enrolling school) and for all other schools of study collaborating in the timetable. For example, if the biology undergraduate is taught for 10% of his first year by the School of Mathematics and 20% of his time by the School of Chemistry, the student is shared among the Schools thus:

School of Biological Sciences .... 0.7 FTEs
School of Chemistry ..... 0.2 FTEs
School of Mathematics ..... 0.1 FTEs

If the student is at the university for only two out of the three terms, his FTE value is proportionately reduced. The computer adds up all of the FTEs attributed to each school and then prints out the consequent loads for resource allocation purposes.

Because there is a close interaction between the university and industry when the student is on his industrial placement, the consequential costs have to be taken into account. During each six-month placement in industry, the student is visited twice by an academic member from his parent school. Academic staff time is expensive, especially in this 1:1 staff-student relationship, and many other costs are involved—for example, travel costs, subsistence, and administration.

Table 1 suggests a simplistic view that as each student is in the university for nine terms throughout the four-year course, and as the usual British degree is of nine terms' duration over three years, the sandwich student FTE load could best be represented as three FTEs spread over the four years (i.e., 2/3 + 2/3 + 2/3 + 1 = 3). This, however, discounts entirely the university input during the sandwich placement.

Costs of a Full-Time Student of Biology

One further point of reference has to be established and that is the average cost of a full-time student of biology. As has been described elsewhere (Taylor, 1982), the U.G.C. provides detailed information on student loads as well as income and expenditures for 51 universities and university colleges in Great Britain, enabling an elaborate computer-aided analysis of costs so as to derive a theoretical expenditure from the "collective wisdom" of the 51 institutions as enshrined in their published accounts.

At this stage, two points must be emphasised:

1. The average cost per student derived from the analysis has no intrinsic merit except to prompt questions about deviations from the average; it offers no explanations. Each autonomous institution can provide its own answers.
2. The quality of the results of the analysis must depend upon the precision of the definitions (for example, of FTEs) on which the returns are based.

Table 2 shows the expenditure pattern of the average British university in 1979-80 in support of a biology undergraduate *FTE* for one year. The cost of three years of a full-time course at 1979-80 prices would be £12,441, excluding living costs for the student.

It is appreciated that there is a small element of circularity in the argument (that is, average FTE costs shown in Table 2 have been biased slightly because placement costs have been taken into account by the few universities offering sandwich courses), but the effect is so small as to be negligible.

Table 2

The Itemised Costs of One Biology Undergraduate (= u/g) FTE for One Year Based on the Great Britain Average for 1979-80

(Note: The average excludes Oxford, Cambridge, and London because of exceptional expenditure patterns.)

Expenditure Heading	Cost £s
Departmental Expenditure	
Academic salaries	1,130
Support salaries	730
Consumables & other	290
Sub-total	2,150
Non-Departmental Expenditure	
Library salaries	83
Library other	75
Computers	67
Audio-visual aids	15
Other academic services	29
General educational expenditure	
Examinations	10
u/g prizes	4
Vacation grants & field studies	15
Other general educational expenditure	58
Premises expenditure	
Space related	
Local government rates, insurance	
Heat, light, water & power	
Repairs, maintenance, cleaning & security @ £44/m²	
27 m² *for each biology FTE*	1,188
FTE related	
Rent, telephones & other	54
Administration & central services	
Salaries & wages	172
Other expenditure	94
Staff & student facilities	
Careers, wardens, student societies, accommodation, catering deficit, health	
Athletic facilities	75
Miscellaneous	50
Transfers to furniture & equipment account	8
Sub-total	1,997
Grand Total	4,147

Table 2 is strictly of average costs in which each value is a combination of a share of the fixed cost plus the marginal cost appropriate to the student load in the year.

Within the university, changes in recruitment patterns do occur and under these circumstances an analogue of Table 2 is used. The costs in the analogous table are derived from partial regression analyses of costs of all British universities which take into account levels of study and mixtures of students. These analyses enable a distinction to be made between marginal and fixed costs, as previously described, and clearly it is the marginal cost differences which dominate the allocation of resources. The comparative analyses of differential costs between full-time and sandwich courses necessarily take into account a proportion of the fixed costs.

The detailed costs in Table 2 form the basis for amendment to take into account variation in the course pattern. In Bath we offer, as well as full-time traditional courses, five different patterns of sandwich courses, each of which imposes its distinctive demands on resource allocation. The basic annual cost is modified to take into account the particular costs imposed by a sandwich course.

This paper focuses on the patterns illustrated in Table 1, but the principles described are readily adaptable to any of the other patterns. The full-time cost is proportioned on the basis of the student's attendance at the university, and to this figure are added the costs which flow from his placement in industry.

Sandwich Placement Costs

Costs result from placing a student in an industrial work environment, and these differ from course to course in the university, depending upon the duration of the placement and the amount of university supervision and interaction with the student and with industry during the period. In the case of the applied biology student, the average academic staff time commitment per student is summarised in Table 3. These duties of supervision, tutorials, and visits are laid down in rules for the conduct of sandwich courses. The time taken on the visits is an average based upon the distribution of the locations of the industrial placements.

Table 3

Academic Staff Time Commitment for Each Student Placement

Time Usage	Time Devoted (hours)
Time to arrange placement (including an element for securing new placements to add to stock)	4
Pre-training briefing tutorial (including description of the firm, its objectives, etc. and what is expected of the student)	2
Setting and marking correspondence tutorial work	4
Debriefing, editing, and marking the student's industrial report and consequent individual tutorials	4
Two visits to student in industry during placement — an average of 10 hours each including traveling	20
Total per Student Placement	34

The *Enquiry into the Use of Time by University Academic Staff: 1969-70* (Committee of Vice-Chancellors & Principals, 1972) indicated that the average British lecturer spends about 18.5 hours per week on student-orientated activities (instruction, marking, etc.)—that is, 555 hours in a 30-week academic year. The average academic time commitment per student during the six-month industrial placement is 34 hours,

as shown in Table 3. Hence, this can be translated into 34/555 = 0.06126 of an academic. The average cost of an academic in 1979-80 was £11,200, and the proportion attributable per student supervised during the work experience is therefore £686.

Departmental Support Staff Costs

So there are additional academic staff (with consequent costs) appointed to satisfy a load demand generated by the placements. The existence of these staff require additional support staff in the department. The clerical needs of the placement system and the technical work load of the academic staff both have to be catered to. This is an area in which more investigation would refine the costings that follow, which are presently founded on experience and generalisations. The costs described relate to the thin sandwich pattern, and analogous arguments have to be applied for other course configurations.

As a compromise, it is suggested that support staff activities are divided between direct student-generated and staff-generated activities. For example, a British university teacher is required to perform personal research for about one-third of his time, so the existence of extra academic staff implies a consequential need for technical and clerical support staff and all other facilities required in support of that research. From Table 2, it can be seen that for every £1 spent on academic staff provision, £0.65 was spent on support staff salary costs in the department (£730/£1130). Hence, £686 of academic staff cost for the placement is worth £446 of support staff salary cost. If we assume that the student on placement diminishes the load on support staff by 50% (i.e., there is still a need to support the academic staff in their research capacity, the arrangement of placements, etc.), then each placement is worth £223 of support staff costs.

Departmental Consumables

By a like argument, for every £1 spent on academic staff provision, £0.26 was spent on consumables, sundry expenditure, maintenance, and training grants. The consumable budgetary demand of a student on placement is negligible, but there is still a demand from the extra academic staff argued for previously. It is suggested that 25% of the expenditure in this category is due to the existence of the staff rather than the students. The calculation then becomes: (£686 x 0.26) x 25% = £44.59.

Traveling Costs

For each tutorial visit to a student on placement, the academic receives fares and subsistence at an average of about £30. Students are placed all over the United Kingdom, and visits tend to be arranged as a tour by the tutor. Students are also sent to overseas placements when the university is assured of the quality and perception of its objectives by the employers, but such students are not visited, for reasons of economy. Each student on placement in the U.K. is visited twice during the six months; hence, the attributable cost is £30 x 2 = £60.

Departmental Cost Summary

As a student is placed in a different industry for each of his industrial experiences, "there is no economy to be found in the briefing sessions shown in Table 3. Hence, the departmental cost of each student sent on placement can be summarised thus:

Academic staff cost	£686
Support staff cost	223
Consumables, etc.	45
Travel and subsistence	60
Total per placement	£1,014

It will be appreciated that the enrolled biology student is taught by other departments (e.g., chemistry and mathematics), so the actual cost of producing a graduate is different from the costs indicated on the following tables (which imply that four biology FTEs = one biology graduate). There is a complex interaction among departments, but all syllabi are in the form of computer programmes; therefore, the real sorting out of the issues involved, so as to give an accurate representation for resource allocation, is done by the computer.

Cognizance is also taken of the distinction between an average unit cost and the marginal cost, where there is validity in so doing. The total student load in my own institution is stable and, as it is likely to remain so, we cannot look forward to the economies of marginal costings which tend to accompany institutional growth. On an internal basis however, there are changes in emphasis, with growth of one subject accompanied by compensatory shrinkage elsewhere, and under these circumstances, marginal costings are appropriate for the allocation of resources.

The cost of £1,014 deduced previously can now be accumulated with the departmental costs shown in Table 2 to estimate the annual cost of a biology FTE undergraduate with the university's particular sandwich pattern at 1979-80 prices. Two terms of full-time tuition are worth £2,150 x 2/3, to which is added the placement costs of £1,014 to give an annual total of £2,447 for each of the first three years, as shown in Table 4. The fourth year is full time, with the resultant £2,150 entry. Table 4 indicates that the departmental cost over the four-year course is £9,491, or £2,373 per sandwich-student-year, in contrast with the £2,150 per year of the full-time student. From a departmental viewpoint, the sandwich FTE is 10% more expensive than the full-time FTE in *each* year of the course.

Non-Departmental Costs during Placements

Non-departmental costs are also affected by the absence of students on placement. Sandwich courses in biology compel an uneconomical use of space because of the needs of a seasonal industry. Having all of the students on placements simultaneously results in a peak loading on the university for the first two terms in the academic year—that is, space has to be provided and serviced whether the students are present or not; the additional staff have to be accommodated; and so on.

Table 4

Departmental Code of a Biology FTE Sandwich Student at 1979-80 Prices

Key: ft = full time

Year	Cost	
	Make-up	Total £s
Year 1 2 terms ft placement	£2,150 x 2/3 £1,014	£2,447
Year 2 2 terms ft placement	£2,150 x 2/3 £1,014	£2,447
Year 3 2 terms ft placement	£2,150 x 2/3 £1,014	£2,447
Year 4 3 terms ft	£2,150	£2,150
Total Cost		£9,491

Under "premises expenditure" in Table 2, it was indicated that the full-time student generates a demand for 27 sq. m. (gross). Almost all of this has to be provided because of the nature of the sandwich pattern.

There are savings to be made during the placement period. For example, the full-year cost of the library is £158/FTE; hence, the one-term cost during the placement is one-third. Accepting that 50% of library usage is by staff rather than by students, the placement cost of the library is £(158/3/2) = £26. Although premises provision is 100%, many of the costs which stem from usage (e.g., cleaning, heat, light, power) can be reduced to 50% during the placement. An alternative argument is that these are fixed costs, so that the placement increases the *average* cost.

Table 5

Non-Departmental Costs of a Biology FTE Sandwich Student at 1979-80 Prices

Key: ft = full time

Year	Cost	
	Make-up	Total £s
Year 1 2 terms ft placement	£1,997 x 2/3 £457	£1,788
Year 2 2 terms ft placement	£1,997 x 2/3 £457	£1,788
Year 3 2 terms ft placement	£1,997 x 2/3 £457	£1,788
Year 4 3 terms ft	£1,997	£1,997
Total Cost		£7,361

By such a series of similar arguments relating to the non-departmental expenditure in Table 2, the cost during the placement is estimated as £457. This enables the construction of Table 5 as the non-departmental equivalent of Table 4. The non-departmental cost of the four-year sandwich course is therefore £7,361—£1,840 per student-year in contrast with the £1,997 per student-year of the full-time student. The sandwich-student annual cost is therefore 92% of the full-time annual cost.

Combining the data in Tables 4 and 5 gives the grand total of £16,852 (£9,491 + £7,361) for the four-year sandwich course at 1979-80 prices (i.e., an average annual cost of £4,213, which contrasts with the full-time corresponding annual cost of £4,147). The annual unit cost of the sandwich student is 2% higher than that of the traditional student.

Thick Sandwich Economies

Let us suppose that the biology sandwich pattern were changed to that of the chemistry degree at Bath, so that students attended the university full time for Years 1, 2, and 4 and spent Year 3 in industry, on two six-month placements. Departmental costs would then become those shown in Table 6.

Table 6

Departmental Costs of a Hypothetical Thick Sandwich FTE Biology Student

Year	Cost (£s)	
	Make-up	Total
Years 1, 2, and 4 (full time)	£2,150 x 3	**£6,450**
Year 3 (two 6-month placements)	£1,014 x 2	**£2,028**
Total Cost		**£8,478**

The average annual departmental cost of £2,120 is 99% of the full-time figure. The real economies come in the non-departmental costs and, in particular, those relating to the premises. Although the peak load of the thin sandwich pattern demands a full provision of space, with marginal economy due to servicing that space, the thick sandwich represents a considerable lessening of need for the space in the first place, with a commensurate servicing economy.

The thin sandwich student on placement (when all are placed at the same time) generates a gross area demand of 27 sq. m. because such space has to be provided during the first two terms. If this need is removed by the thick sandwich pattern, the only remaining commitment for the third placement year is for academic and support staff, estimated at 8 sq. m. From Table 2 it can be seen that the space-related premises expenditure is £1,188 for the 27 sq. m. needed for the full-time student. This figure is the cost of *servicing* the 27 sq. m. of space and *not* its construction or furnishing. Of this sum, £915 is attributable to rent, repairs,

insurance, maintenance, cleaning, and custody; the remainder is for energy and water. The £915 can be proportionately reduced by a factor of 8/27 to £271 for the year and to £136 for each placement.

There are analogous arguments for the other categories of non-departmental expenditure, and the estimate of a placement cost for a thick sandwich student is £361. Table 5 can now be reconstructed for the thick sandwich, as is shown in Table 7.

Table 7

Non-Departmental Costs of a Hypothetical Thick Sandwich FTE Biology Student

Year	Cost (£s)	
	Make-up	Total
Years 1, 2, and 4 (full time)	£1,997 x 3	£5,991
Year 3 (two 6-month placements)	£361 x 2	£722
Total Cost		**£6,713**

Coalescing the totals from Tables 6 and 7 indicates an average annual cost of £3,798 for the thick sandwich student instead of the £4,147 average cost for the full-time student. The thick sandwich annual cost is only 92% of the full-time cost. The full comparison of costs of the different sandwich patterns with full-time costs is given in Table 8.

Discussion

The British system of funding of university education, with its consequential detailed expenditure reporting, facilitates that analysis of unit costs with considerable accuracy. This is exploited by the proportional allocation of costs to various patterns of activity within the university, to which are added the special costs attributable to the extramural supervision of students.

From the viewpoint of recurrent costs, which in the case of the University of Bath are paid largely by the government from general taxation, the four-year sandwich graduate is either 22% or 35% more expensive to produce than the graduate from a three-year, full-time course, in recurrent cost terms (Table 8). The allocation of resources within the university reflects the differential costs implied by these analyses.

Maintenance and subsistence grants in support of the students are equal in all three patterns. The local education authority funds nine terms in the university, and the employer pays a wage to the student during placements.

This paper, so far, has dealt only fleetingly with capital provision (i.e., permanent buildings), indicating that the full-time biology student generates a demand for 27 sq. m. gross, which remains the same for a thin sandwich student. The thick sandwich student, however, generates a demand for only 8 sq. m. during the placement year, so the averaged demand over the four years is ((3 x 27) + 8)/4 = 22.25 sq. m.

The cost of servicing the space (i.e., insurance, energy, telephones, etc.) has been dealt with previously. There is an opportunity cost associated with the creation of the usable space in the first place, and this cost element is now considered.

Assuming that there are no losses from the enrolled students during their courses and that capital building costs are £425 per sq. m., it is possible to translate the space demands into monetary terms, thus:

Full-time and thin sandwich student:	27 x £425 = £11,475
Thick sandwich student:	22.25 x £425 = £9,456

Using standard investment appraisal methods (H.M. Treasury, 1980) assuming a building life of 30 years, and discounting at a rate of 5%, these capital sums can be represented as annual costs as follows:

Full-time and thin sandwich student:	£747/annum
Thick sandwich student:	£616/annum

In the United Kingdom, the U.G.C. provides the capital funding for buildings, which expenditure is then written off, so recurrent costs at the university level do not have to reflect a servicing interest on the initial

Table 8

Recurrent Cost Comparisons between Full-Time, Thin Sandwich, and Thick Sandwich Students

Course Pattern	Total Cost of Producing a Graduate and the Percentage Relationship with Full-Time Costs £s and (%)			Per-Annum Average Annual Cost £s and (%)
	Departmental	Non-departmental	Total	
3 years (full time)	6,450 (100)	5,991 (100)	12,441 (100)	4,147 (100)
4 years thin sandwich (3 6-month placements)	9,491 (147)	7,361 (123)	16,852 (135)	4,213 (102)
4 years thick sandwich (2 consecutive 6-month placements)	8,478 (131)	6,713 (112)	15,191 (122)	3,798 (92)

funding. In a cost-benefit analysis applied by a society willing to fund more buildings, the opportunity costs would include this element, hence the comparison of costs between sandwich and full-time courses properly includes this sum.

If the capital provision is taken into account by adding the investment appraisal figure to the recurrent expenditure, it costs 35% more to produce a thin sandwich biology graduate than it does to produce a full-time biology graduate in the University of Bath. A switch to the more economical thick sandwich pattern would reduce this differential to 20%. These percentages derive from the simplification that the School of Biology teaches the student exclusively, whereas such is not the case. However, when teaching by collaborating schools of study is taken into account, each with its own costings, the only change which results is in the monetary values in Table 8. The relative percentages do not change significantly.

Is the difference worth it? What does society get in return for this additional investment of resources? The answer to these questions resides in the programme results. If U.K. universities are listed in rank order of the employability of their graduates, the University of Bath is at or close to the top of the list every year. This earns such headlines as, "If You Want To Get a Job, Go To Bath." Therefore, more candidates seek admission and the university can be more selective—thus improving the quality of its entrants and, by inference, its graduates, who are then even more employable, and so on. It is a highly beneficial form of positive feedback.

Many schools in the university offer concurrent sandwich and full-time degree courses, with the sandwich stream being the objective of most students. However, transfer to the sandwich stream is open only to the "high fliers."

The employers, candidates, and graduates are clearly satisfied with the educational merits of sandwich courses. The fact that employers are pleased to support students on placement, in the hope of ultimately recruiting the graduates, is an added encouragement to the university to suppose that the additional costs are justified.

The author has argued that additional academic staff are required in order to provide the necessary support for the sandwich system. It has been suggested that this is an extravagant way to conduct the university's affairs. Why not recruit a liaison officer charged with placement arrangements and student visits to minimise many of the costs cited? The attitude of the university is that there is no reason why teachers of sandwich students should not enjoy normal conditions of work and engage in the normal amount of personal research which, in turn, will attract the average research income and the average number of postgraduate research students. In other words, the other components of staff time usage will flow from the presence of the undergraduate load. The university feels that it would be inappropriate to have a liaison officer who would inevitably be different in kind from the other academics.

Another great advantage flows from this attitude. All members of the academic staff are expected to play their part in the process of visits to students during their placements. Every year, each academic is thus exposed to the excitements and problems of industry, commerce, and research organisations, and to the demands of society. The syllabi at the University of Bath are refreshed very often to reflect the latest developments, and the process is a great stimulant to collaborative and "relevant" research. Such a socially appropriate refreshment of our mission is difficult to evaluate from a cost-benefit viewpoint—but it is a substantial contribution to the maintenance of the usefulness of the university's role in society.

The greater cost of sandwich courses, as operated in the University of Bath, is undeniable, and the defense of the system must rest on less quantifiable aspects, such as the value of the end product to society. In this respect, the most secure defense is to make a good job of the training, such that employers find the graduates significantly more employable than graduates produced on traditional courses.

At the moment, the university is in this position, but if government-imposed economies are too savage, the integrated training aspect of sandwich courses may be more vulnerable than other aspects of the university's expenditure, and the advantage may be eroded. There are signs of this degradation in some other British universities offering sandwich courses.

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